

# SOME NEW MOLLUSCA FROM THE SILURIAN FORMATIONS OF WASHINGTON COUNTY, MAINE.

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## INTRODUCTION.

In the course of preparing the monograph on the Chapman Fauna of Aroostook County, Maine, I published two short papers in these proceedings which properly belong to this series of papers on the Paleozoic fossils of Maine, as follows:

No. 1. A new Brachiopod, *Rensselaeria mainensis*, from the Devonian of Maine.<sup>1</sup>

No. 2. On the revision of the Mollusk genus *Pterinea* Goldfuss.<sup>2</sup>

The present paper constitutes the third issue of this series.

In the second paper the new genera *Tolmaia*, *Follmannella*, *Actinopterella*, and *Cornellites* were described.

The type-species of the genus *Tolmaia* is *Pterinea lineata* Goldfuss, and the species *Pterinea* (*Pteronitella*?) *incurvata* Clarke,<sup>3</sup> described from the Lower Devonian of Dalhousie, New Brunswick, is referred to as probably belonging to this genus. The type of the genus *Follmannella* is *Pterinea mainensis* Clarke, from the Eodevonian of Moosehead Lake region in Somerset County, Maine.<sup>4</sup>

The type of the genus *Actinopterella* is *Pterinea radialis* Clarke, part, from the Chapman sandstone on Presque Isle stream, Chapman Plantation, Aroostook County, Maine.<sup>5</sup>

The types of the last two genera from the same localities had already been described and named in manuscript by the writer when Clarke's paper was published, and other species of these genera are described in the monograph on the Chapman fauna now (January, 1912) in course of publication by the United States Geological Survey.

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<sup>1</sup> Proc. U. S. Nat. Mus., No. 1527, vol. 32, pages 267-269, published April 18, 1907.

<sup>2</sup> Idem, No. 1600, vol. 34, pages 83-90, published April 17, 1908.

<sup>3</sup> N. Y. State Mus., Bull. 107, 1907, p. 210.

<sup>4</sup> Idem, p. 201.

<sup>5</sup> Idem, p. 207.

The following species are published to illustrate the paleontology of the Eastport quadrangle of Washington County in the southeast corner of Maine, the field work on which has already been completed by a party of the United States Geological Survey in charge of Edson S. Bastin, who has in course of preparation the folio maps of the Eastport quadrangle.

EURYMYELLA, new genus.

Shell thin, subtriangular in outline, compressed, high and subalate posteriorly, narrowed anteriorly, the front curving regularly from the cardinal angle into the base. Beaks small and low. Umbonal ridge moderately elevated, rounded or subangular. No mesial sulcus. The surface forward and downward from the umbonal ridge is slightly convex or flattened, not concave. Hinge line straight, narrow, slightly thickened at edge, generally without distinct teeth. A small obscure thickening of the hinge is seen in an occasional specimen under the beak of the right valve, with a broader thickening in the same position in the left valve, and in a single specimen a linear thickening of the inner edge of the hinge margin is evident near its posterior end. Ligament linear, external.

Anterior adductor impression distinct, situated close under the hinge, subovate, sharply defined on the inner side by a strong, short ridge coming down from the hinge border. Posterior muscular scar too indistinct for description. Pallial line simple. Umbonal and pedal muscular pits present on the sides of the umbonal cavity and behind the anterior muscular scar in some specimens.

*Type-species.*—*Eurymyella shaleri*, new species.

REMARKS ON THE GENUS EURYMYELLA.

The genus *Eurymyella* is erected for a group of fossil Pelecypoda found abundantly in the shales of Moose Island, Eastport, Maine. The fossils were noted by N. S. Shaler in a paper on the Geology of the Cobscook Bay District, Me.,<sup>1</sup> as “*Modiomorpha*, allied to *M. subulata*,” and the particular localities named by Shaler are “Shackford Head,” a promontory on the west side, and “Princess Cove,” on the south end of Moose Island. The rocks containing them constitute the upper formation of the Silurian series called by Shaler the “Cobscook Bay series.” They are immediately overlain, unconformably, by the Perry formation, the flora of which is fully described by David White and assigned to the Devonian age.<sup>2</sup>

By “*Modiomorpha subulata*” is probably intended *Cypricardites subulata* Conrad,<sup>3</sup> described by Conrad as from the “shales near

<sup>1</sup> Amer. Journ. Sci., ser. 3, vol. 23, 1886, p. 58.

<sup>2</sup> Smith and White, Geology of the Perry Basin in Southeastern Maine. U. S. Geol. Surv., Prof. Paper No. 35, 1905.

<sup>3</sup> 5th Ann. Rept. Geol. Surv., New York, 1841, p. 53.

Apulia [=Hamilton formation], Onondaga County, N. Y., tab. No. 22, Ithaca," but not figured. The specific name was spelled *subulata* in the list<sup>1</sup> given by Conrad. The same spelling is used in referring to it in the list of species of the Hamilton in Vanuxem's final report.<sup>2</sup> In the final report on the Paleontology of New York State<sup>3</sup> Hall figured this species under the name *Modiomorpha subalata*, referring it to the genus *Modiomorpha* which he had described and named in 1870.<sup>4</sup>

In reporting this Eastport fauna in 1905 Williams<sup>5</sup> recognized Shaler's reference of this species to the genus *Modiomorpha* and tentatively to the species of *subulata* Conrad, and it was upon this identification that the Devonian age of the formation was inferred. In the same paper Schuchert listed species from Carlow Island and north end of Moose Island under the names "*Whiteavesia* sp. new," "*Modiolopsis* sp. undetermined," and "*Psiloconchoid pelecypod*." In the first case it was associated with "*Leperditia* of the *L. alta* type," thus bringing in a new means of correlation. Schuchert rightly determined the age as "unmistakably Siluric and beneath the Helderbergian."<sup>6</sup>

Later investigations have fully confirmed the correctness of Schuchert's conclusion that the Carlow Island and Moose Island faunas are alike, and the same species of *Eurymyella* occur in both.

Critical examination of a large number of specimens brought together in the recent survey of the Eastport quadrangle has made it clear to the writer that these Eastport modiolopsoid forms differ from both *Modiomorpha* Hall<sup>7</sup> and *Modiolopsis* Hall<sup>8</sup> in the absence of a median sulcus in front of the umbonal ridge. In this particular they agree with McCoy's genus *Anodontopsis*<sup>9</sup> and Ulrich's genera *Whiteavesia*<sup>10</sup> and *Eurymya*.<sup>11</sup> The mistake in generic reference of the species made by Shaler and Williams (as probably also by others) was due to the fact that the larger specimens are often grooved in the place of the natural median sulcus of *Modiomorpha* and *Modiolopsis*, due (as has been learned by careful inspection) to the crushing of the very fragile shells. Such specimens show the shell to have been cracked along this line, but when uncrushed the shell is found to have the ventral margin convexly curved throughout and has no byssal

<sup>1</sup> 5th Ann. Rept. Geol. Surv., New York, 1841, p. 36.

<sup>2</sup> N. Y. Geol., 3d District, 1842, p. 162.

<sup>3</sup> Nat. Hist. N. Y., vol. 5, pt. 1, Lamellibranchiata, II, 1885, p. 283, pls. 35 and 39.

<sup>4</sup> Prel. notice, Lam., Shells, pt. 2, 1870, p. 72.

<sup>5</sup> U. S. Geol. Surv., Prof. Paper 35, p. 24.

<sup>6</sup> Idem., p. 26.

<sup>7</sup> Hall, J., Prel. notice, Lam., Shells, pt. 2, 1870, p. 72.

<sup>8</sup> Hall, Nat. Hist. N. Y., Pal., vol. 1, 1847, p. 157.

<sup>9</sup> McCoy, F., Ann. and Mag. Nat. Hist., ser. 2, vol. 7, 1851, p. 54.

<sup>10</sup> Ulrich, E. O., Geol. and Nat. Hist. Surv. Minnesota, Final Report, 1894, p. 513. (Note: in the text the name used is *Actinomya*, but on page 628 the name *Whiteavesia* is substituted for *Actinomya*, which was found to be preoccupied.)

<sup>11</sup> Ulrich, Idem, p. 512.

furrow or median sulcus in perfectly preserved specimens. The species *Modiolopsis cincinnatiensis* Hall and Whitefield is taken by Ulrich as genotype of his genus *Whiteavesia*, although we find contained in the original definition of that species the characters upon the absence of which the new genus was based. The specific definition includes the following clauses: "Basal line gently curving throughout its length in most cases, but in some examples becoming slightly sinuate opposite or a little posterior to the beaks," and "an obscure, shallow mesial depression extends across the valves from the beaks, reaching the basal line just behind the anterior third of the length."<sup>1</sup> This is inconsistent with that part of the generic definition of *Whiteavesia* which reads, "Base gently convex, occasionally straight, never sinuate. Mesial sulcus wanting."<sup>2</sup>

Our genus *Eurymyella* agrees with the generic definition of Ulrich's *Whiteavesia* in the gently convex or straight base and absence of mesial sulcus, but differs from it in lacking the "radii or divaricating folds" which are described in the definition and reproduced upon the illustration given of the genotype *Modiolopsis cincinnatiensis*<sup>3</sup> and more distinctly expressed by *M. cancellata* Walcott,<sup>4</sup> which is the second species cited as representing the genus *Whiteavesia*. *Eurymyella* also differs from *Whiteavesia* in its hinge. Whereas in *Eurymyella* the hinge plate is typically very narrow at the sides and without lateral teeth, it is fairly strong under the beaks and has a cardinal tooth or teeth expressed there in both valves. It also differs by its small low beaks. The beak is described as "comparatively large, full, and rather prominent" in *Whiteavesia*.<sup>5</sup>

*Eurymyella* very closely resembles Ulrich's genus *Eurymya*, which fact has suggested the name here proposed. The chief difference discovered is in the hinge. The hinge of *Eurymya* is described as "strong with a broad longitudinally striated ligamental area posterior to the beaks and beneath them an obscure cardinal fold or tooth in the left valve and a corresponding depression in the right." The "presence of a striated ligamental area" is specifically named as one of the four principal distinguishing features, separating *Eurymya* from *Modiolopsis*. The genus *Eurymyella* has the obscure cardinal teeth under the beaks, but the lateral parts of the hinge area are, in the typical forms, scarcely more than a linear thickening of the shell margin, and thus lack one of the essential characters of Ulrich's genus *Eurymya*.

The type-species of *Eurymyella* (*E. shaleri*) agrees still more closely with *Anodontopsis angustifrons* McCoy in its external appearance;

<sup>1</sup> Pal. Ohio, vol. 2, pt. 2, 1875, p. 88.

<sup>2</sup> Ulrich, Geol. and Nat. Hist. Surv. Minnesota, Final Rept., 1894, p. 514.

<sup>3</sup> Ulrich, *Idem*, p. 514, fig. 39a.

<sup>4</sup> Trans. Albany Inst., vol. 10, 1879, p. 22, pl. 1, figs. 8 and 8a.

<sup>5</sup> Ulrich, Geol. and Nat. Hist. Surv. Minnesota, Final Rept., 1894, p. 514.



in fact the figure 15<sup>1</sup> of that species is a fairly good figure of some of the large specimens collected from Eastport. Here again, however, it is the hinge, as described for the genus *Anodontopsis*, which excludes our species from the McCoy genus. McCoy describes the hinge as follows: "Hinge line shorter than the shell, with a posterior, long, slender tooth or cartilage plate extending just below it (double in the right valve), and another similar but shorter one in front of the beaks \* \* \* (occasionally one small cardinal tooth beneath the beak)." <sup>2</sup>

In no specimen of the type-species of *Eurymyella* have lateral cardinal teeth been discovered. In one species and specimen (*Eurymyella convexa*) there is seen a single short, rather oblique linear groove which may be the mold of a lateral tooth near the extreme posterior end of the hinge area.

At the close of the definition of the species *A. angustifrons* McCoy, we note the statement: "The posterior lateral tooth or plate extends almost to the end of the hinge line and close to it." <sup>3</sup> It is not unreasonable to imagine that the obscurity of the hinge characters in these forms is the result of degeneration coincident with a brackish-water environment forced upon a race, the normal representatives of which were marine and possessed more definite development of lateral teeth. In fact this interpretation is suggested by finding in the lower beds on Denbow Point, associated with brachiopods of strictly marine habitat, a species which expresses the generic characters of *Eurymyella* with the added characters of thickening of the shell and widening of the hinge area. (See *Eurymyella denbowensis*, p. 390.) But as a matter of strict definition of characters the typical forms are, by the feeble development of the hinge characters, excluded from the genera *Anodontopsis*, *Eurymya*, and *Whiteavesia*, which they closely resemble in exterior character, and it becomes necessary to erect a new genus to include them.

Both the history of the faunas leading up to the formation in which the *Eurymyella* appear and the associated species (*Lingulas*, ostracods and a few small gastropods) and the fact that the formation is terminated by unconformity, suggest that the environmental conditions were in shallow water near the ocean, but, probably, brackish and not pure salt water.

**EURYMYELLA SHALERI, new species.**

Plate 49, figs. 1, 2, 3, 4.

Shell rather small, thin, fragile, compressed, subtriangular in outline; hinge line straight, long, forming with the umbonal ridge a triangular flattened area or wing. Posterior and anterior extremi-

<sup>1</sup> Brit. Pal. Fossils, 1855, p. 271, pl. 1k, fig. 15.

<sup>2</sup> Ann. and Mag. Nat. Hist., ser. 2, vol. 7, 1851, p. 54.

<sup>3</sup> Idem, p. 55.

ties of hinge rounded, angle between umbonal ridge and hinge margin about  $50^{\circ}$ . Anterior slope convex, no indication of mesial sulcus. Surface nearly smooth, a few obscure concentric wrinkles of growth are seen over the outer half of the shell and well-preserved shells show faint, irregular, fine, concentric lines.

Size variable, but rarely over 1 inch in length; the large majority of specimens are from one-half to three-fourths of an inch long.

Interior molds occasionally show a distinct anterior muscular scar, but in no specimen has the outline of the posterior scar been traced. The anterior scar is strongly impressed, situated at the extreme antero-cardinal angle below the hinge, and is bounded by a short, strong ridge on the inside. Pedicel scars are frequently seen on the area between the posterior edge of the anterior muscular scar and the bottom of the cavity of the beak. On the anterior side of the umbonal cavity three small, oval pits are seen near the apex and occasionally a fourth half way down toward the anterior adductor.

The cardinal margin in most specimens exhibits little else than a slight thickening of the edge of the very fragile shell. In a few specimens trace of a small oblique thickening of the hinge is seen under the beak of left valves and on right valves a somewhat broader thickening, which perhaps represents two teeth between which the right tooth fits. In most cases the lateral hinge margins are too narrow for the exhibition of any distinct lateral teeth, and the valves are separate in fossilization, although there are many cases of attached valves.

*Dimensions of the type-specimens.*—(1) Length 22 mm., height 15 mm.; (2) length 19 mm., height 14 mm.; (3) length 23 mm., height 15 mm.; (4) length 19 mm., height 14 mm.

*Locality.*—The typical locality is in the shales on Moose Island at Shackford Head and on the shores of Broad Cove, where the species is found in great abundance with rarely any other fossil species except *Lingulas* and ostracods.

*Cotypes.*—Cat. Nos. 58431 to 58433, U.S.N.M.

**EURMYELLA SHALERI, var. BREVA, new variety.**

Plate 49, figs. 5, 6, and 7.

Form and general characters as in *E. shaleri*, but the height is nearly as great as the length, with correspondingly more erect umbonal ridge.

The proportions of three typical specimens are: (1) Length 15 mm., height 14 mm.; (2) length 16 mm., height 15 mm.; (3) length 16 mm., height 14 mm.; and the umbonal angle is  $55^{\circ}$  to  $65^{\circ}$ .

*Locality.*—Same as the typical forms of the species.

*Cotypes.*—Cat. No. 58434, U.S.N.M.

## EURYMYELLA SHALERI, var. LONGA, new variety.

Plate 49, fig. 8.

General characters as in *E. shaleri*, but the length nearly twice as great as the height and the umbonal angle as low as  $35^{\circ}$  or less. The type-specimen measures: Length 20 mm., height 12 mm., umbonal angle =  $35^{\circ}$ .

*Locality*.—Same as the typical forms of the species.

*Holotype*.—Cat. No. 58435, U.S.N.M.

## EURYMYELLA SHALERI, var. MINOR, new variety.

Plate 49, fig. 9.

General characters of both form and proportions as in *E. shaleri*, but averaging about half the size of typical *E. shaleri*.

*Type-specimen*.—Length 13 mm., height  $8\frac{1}{2}$  mm., umbonal angle about  $50^{\circ}$ .

*Locality*.—Carlow Island.

*Holotype*.—Cat. No. 58436, U.S.N.M.

## EURYMYELLA ANGULARIS, new species.

Plate 49, figs. 10, 11.

Shell irregularly pentagonal in form; height four-fifths the length; beak low, scarcely protruding beyond the hinge margin. Hinge line long, straight, from the extremities of which the sides, both anterior and posterior, proceed at nearly right angles. The front margin for nearly one-fourth of the height of the shell is nearly straight, thence turns rather abruptly backward at an angle of  $130^{\circ}$  to the middle of the ventral margin in a slightly convex line to the angular termination of the umbonal ridge. The umbonal ridge makes an angle of about  $70^{\circ}$  with the posterior part of the hinge line. In the type-specimen the flattened area back of the main umbonal ridge is crossed by a second slightly shorter, low ridge, neither ridge sharply defined, but expressed in the slight deflection of the concentric lines, and by flattening of the surfaces between them and between the latter and the posterior hinge margin. The termination of the second ridge causes a blunt angle in the posterior margin. The surface is marked by fine, concentric lines and occasional laminar foldings of the surface. The general surface is low-convex; the umbonal region low and flattened; the highest arching of the surface is subcentral.

Dimensions of type-specimen (a left valve): Length of hinge margin, 22 mm.; length across middle of shell, 24 mm.; posterior height, 20 mm.; height of front side, 9 mm.; main umbonal angle,  $70^{\circ}$ .

A right valve from the same locality shows the deflection of the concentric lines on the middle of the posterior slope, but the surface

does not show the low, angular elevations seen in the left valve. In this right valve the umbonal angle with the posterior part of the hinge is nearer  $80^{\circ}$  than  $70^{\circ}$ .

*Locality*.—East side Seward Neck.

*Holotype* and *paratype*.—Cat. No. 58437, U.S.N.M.

**EURMYMYELLA ? SIMULANS, new species.**

Plate 49, figs. 12, and 13.

Shell small, modiolopoid in form, with straight hinge line, beak slightly arching over the hinge border, flattened, not prominent, situated about one-third distance back from front end of hinge. Posterior margin nearly at right angles with the cardinal margin; anterior end narrow. Umbonal ridge broad, not sharply defined. Posterior slope plano-convex to the posterior margin. In front of the umbonal ridge there is a broad, shallow furrow, producing a slight reentrant curve to the lower margin of the shell. This character, strictly speaking, removes the species from the genus *Eurymyella*, the entire absence of a mesial sulcus having been adopted as one of the distinctive characters of the genus. It is, however, placed in the genus because of the extremely close resemblance in all other particulars to the abundant representatives of the genus with which it appears associated. There is also the possibility that the appearance of the sulcus, which is quite distinct, may be the result of accident or of abnormal growth. Close examination of the smaller specimen shows a crack line in the bottom of the sulcus, and the larger specimen shows an angular projection of one of the growth-laminæ in the sulcus near the center of the shell. I am of opinion, therefore, that the peculiarity is either a varietal modification of a representative of the genus *Eurymyella* or that this character is due to accident. Surface covered by faint concentric lines and stronger occasional lines of growth.

Dimensions of the type-specimens are: (1) Length, 16 mm.; height, 11 mm. (2) Length,  $23\frac{1}{2}$  mm.; height, 18 mm.

*Locality*.—East side of Seward Neck.

*Cotypes*.—Cat. No. 58438, U.S.N.M.

**EURMYMYELLA PLANA, new species.**

Plate 49, fig. 14.

Shell ovoid in outline, beak greatly depressed, surface gently convex, with greatest convexity in center of the shell. Both cardinal angles rounded, giving to the outline a subregular ovoid form. Surface markings fine, concentric lines, and occasional longer irregular growth lines.

*Dimensions*.—Greatest diameter from the antero-cardinal angle to the postero-ventral margin 25 mm.; greatest diameter at right



angles to this line and about one-quarter diameter in front of posterior margin 16 mm.; estimated depth of shell at middle not over 5 mm. The type-specimen is a left valve.

*Locality*.—East side of Seward Neck.

*Holotype*.—Cat. No. 58439, U.S.N.M.

**EURMYELLA RECTA, new species.**

Plate 49, fig. 15.

Shell triangular, narrow, erect, higher than long; beak small, depressed, nearly central; hinge line short, straight; umbonal ridge low, convex, nearly central and nearly vertical to the hinge line; umbonal ridge trending about  $10^{\circ}$  posteriorly from the vertical.

*Dimensions*.—Greatest length at about 3 mm. below the hinge line, 16 mm.; height from beak to front 21 mm.

This species resembles *E. shaleri*, var. *breva*, but differs by its depressed, flattened beak, indistinct umbonal ridge, more central position of the beak, and larger size. It bears closer genetic relationship to *E. angularis* and *E. plana*, with which it is associated in the same beds.

*Locality*.—East side of Seward Neck.

*Holotype*.—Cat. No. 58440, U.S.N.M.

**EURMYELLA CONVEXA, new species.**

Plate 50, fig. 10.

Shell ovoid, oblique, convex; beak strong but not much produced beyond the hinge line, and situated about one-third way posterior to the front end of the hinge. Hinge line straight, shorter than the greatest length of shell, at posterior end sloping down gradually into the posterior margin; anterior ear narrow. Umbonal ridge broad, convex, highest near middle of shell, its axis forming an angle of about  $45^{\circ}$  with the posterior hinge line. The surface behind the umbonal ridge falls off rapidly to a broad, depressed area, gradually flattening to the tip of the broadly rounded cardino-posterior angle. The anterior ear is small, and from near its tip to the base of the umbonal ridge the margin trends in a broad, regular, convex curve to the ventral margin.

The type-specimen is a mold of the interior of a left valve, and shows the well-defined pit of the anterior muscular scar situate close in front of the ear and upon the hinge line. Three little scars are evident on the front side of the umbonal cavity, and a fourth just above and behind the muscular scar. An indistinct trace of an oblique tooth is evident under the beak, and near the posterior extremity of the hinge a short linear tooth about 3 mm. long is evident. The surface is marked by concentric lines and a few irregular concentric furrows.

The impression of this shell indicates a much stiffer and therefore thicker shell than in most of the representatives of the genus. From its association with the other species and its agreement in the exterior elements of form with the smaller species, I conclude that the development of evident hinge teeth is incident to the fuller development of the shell, and that it may be, generically, associated with the typical *Eurymyella*s with which it agrees in the entire absence of a mesial sulcus which is characteristic of the ordinary forms of *Modiolopsis* and *Modiomorpha*, to which genera these *Eurymyella*s have been frequently referred.

*Dimensions*.—The straight part of the hinge, length 15 mm.; length from front to back at 5 mm. below hinge line, 25 mm.; height at posterior end, 20 mm.; greatest diameter from tip of anterior ear to postero-ventral angle, 30 mm.

The type-specimen of this species was collected by N. S. Shaler and the specimen was identified as "*Modiomorpha* sp. *subulata*" by Shaler and later listed by H. S. Williams as *Modiomorpha* sp. *subulata* var. in United States Geological Survey Professional Paper, No. 35, page 24. The entire absence of the sulcus anterior to the umbonal slope and the discovery that the associated forms, generally of smaller size, are, with scarcely an exception, without this sulcus and present the general outward features of McCoy's *Anodontopsis* *angustifrons*, led to the founding of the new genus *Eurymyella* for the reception of this and associated species.

*Locality*.—Salt Works, Eastport.

*Holotype*.—Cat. No. 58448, U.S.N.M.

EURYMYELLA DENBOWENSIS, new species.

Plate 50, figs. 11 and 14.

Shell subtriangular, obliquely elongate in the direction of the umbonal ridge; hinge line straight, shorter than length of the shell. Beak low, scarcely protruding beyond the hinge line, and situated near the front end. Umbonal ridge subangular, low, running from beak to postero-basal angle; lateral slopes subequal, flattened but slightly convex, no mesial sinus in front of umbonal ridge.

Surface marked by concentric lines of irregular size. Anterior muscular scar, strongly impressed near end and close up to the hinge; two or three small pits between it and the beak cavity. One or two small oblique teeth under the beak; linear thickening, but no distinct posterior lateral teeth are evident. The inner edge of the hinge-area somewhat strengthened at its posterior end.

*Dimensions*.—Greatest diameter from tip of front to extremity of the umbonal ridge of the type-specimen, 28 mm.; greatest diameter near center of shell at right angles to the umbonal ridge, 14 mm.;

straight part of hinge line about 14 mm. Two other specimens reach a greatest diameter of 35 and 40 mm., respectively.

The shell substance of this species is partially preserved in one specimen and the form is well preserved in all specimens seen, showing no evidence of crushing, thus differing from the other species of the genus from the higher formation.

*Locality.*—This species was found in an isolated outcrop near the end of Denbow Point, associated with brachiopods, trilobites, and cephalopods, thus indicating that it lived in marine conditions. In this respect *E. denbowensis* differs from all the other species of the genus here reported, associated with which the only known marine organisms are *Lingulas* and ostracods, signifying that their habitat was littoral, shallow waters, possibly estuarine.

*Holotype* and *paratype*.—Cat. No. 58449, U.S.N.M.

#### CLIOPTERIA, new genus.

A gibbous pterinoid shell, both valves highly arched with prominent over-arching beaks; nearly equivalved, inequilateral. The anterior slope of the right valve marked by one or two radiating, rounded, cord-like ridges and the left valve by corresponding furrows. The posterior slope smooth and more abrupt than the anterior side. Anterior ear small, separated by a shallow sulcus from the main body of shell. Posterior slope gradual and without distinct wing. A high, flattened, triangular area under the beak in both valves. Beaks of both valves overarching. In none of the specimens seen is the dentition of the hinge exhibited.

NOTE.—While this paper was being printed some specimens of *Cliopecteria unicosta* were discovered showing the mold of the hinge margin with distinct teeth. The following characters therefore may be added to the above definition of the genus, viz: Two short lateral teeth near the posterior end and two near the anterior end of the hinge of the right valve; one short strong lateral tooth at each end of the hinge of the left valve. In both valves the margin of the hinge between the lateral teeth is beset by sharply defined denticulations or small teeth.

*Type-species.*—*Cliopecteria bicostata* new species.

#### OBSERVATIONS ON THE GENUS CLIOPTERIA.

This genus is founded for some peculiar small pterinoid shells which bear considerable resemblance to the Devonian species *Avicula dispar* Sandberger as interpreted by Frech, and called by him *Kochia* (*Loxopteria*) *dispar* (Sandberger).<sup>1</sup> The name *Kochia* Frech was introduced to replace *Roemeria* Koch, which was preoccupied by Edwards and Haime, the type of which is *Roemeria capuliformis* Koch, to which our specimens present small resemblances. Frech then created the subgenus *Loxopteria* as a subgenus of *Kochia* to

<sup>1</sup>Die Devon Avicullen Deutschlands, Abh. Geol. Specialk. Preus., vol. 9, Heft. 3, 1891, p. 77, pl. 6, fig. 4.

include three species, of which *Kochia* (*Loxopteria*) *lævis* Frech is first mentioned. To this species our specimens also bear no close resemblance. The second species referred to the subgenus *Loxopteria* is Sandberger's *Avicula dispar*. The large valve of that species, as figured by Frech, bears considerable resemblance to the right valve of our species *Cliopecteria bicostata* (see pl. 50, figs. 1 and 2).

Frech says <sup>1</sup> of his genus:

Den Hauptunterschied zwischen *Kochia* und *Loxopteria* bildet somit die Gestalt der kleinen Klappe; dieselbe besteht bei beiden Gruppen aus zwei windschief zu einander gestellten Flächen, welche sich an einer diagonal verlaufenden Mittellinie berühren. Bei *Loxopteria* stossen der Hinterflügel und der Haupttheil der Schale unter einen einspringender, bei *Kochia* unter einen ausspringenden Winkel an einander; bei letzterer Gattung besteht die kleine Klappe aus einem steil abstürzenden Vordertheil und einer flügellosen Hinterseite.

The left valve of *Cliopecteria*, as shown in figures 3 and 7, differs markedly from both *Kochia* and *Loxopteria* in the strong over-arching beak and its prominent umbonal ridge (as in the *Pterineas* with gibbous left valves) cut on the anterior side by a conspicuous longitudinal furrow.

The close affinity with *Pterinea* is shown by comparing the right valves (see figs. 2 and 4) with the corresponding valve of *Pterinea* as shown in our figure 5a of plate 50. The left valves also bear close resemblances, as seen by comparing figures 3 and 7 with figure 5. The chief difference is in the presence of the two longitudinal ridges on the anterior slope of the species *C. bicostata* and a single ridge in *C. unicosta* as shown in the figures 2 and 4 of plate 50. In external appearance the right valve resembles the right valve of the Triassic *Cassianella gryphæata* Münster from the St. Cassian beds.

CLIOPTERIA BICOSTATA, new species.

Plate 50, figs. 1, 2, 7.

Shell subtriangular, cardinal length shorter than height of shell; beak prominent, subcentral overarching; area of right valve high, triangular, striated parallel to hinge margin. Anterior ear of right valve rounded, short but distinct; posterior cardinal extremity rounded but no distinct wing separate from the posterior slope of the surface.

From the beak of the right valve two strong cordlike ridges proceed toward the front, one near the umbonal ridge and separated from it by a narrow shallow sulcus; the other halfway down the anterior slope and separated from the first by a wide furrow and terminating at the middle of the anterior border (see fig. 2). A left valve of apparently the same species (see fig. 7) shows a deep furrow proceeding from tip of beak on the anterior side of the umbonal

<sup>1</sup> Die Devon Aviculiden Deutschlands, pp. 75-76.



ridge followed on its anterior side by a strong ridge on the anterior slope. Except for these ridges and furrows, the surface is apparently smooth.

*Locality*.—Limestone band in the shales at northwest corner of Youngs Cove, Pembroke Township.

*Holotype*.—Cat. No. 58441, U.S.N.M.

CLIOPTERIA UNICOSTA, new species.

Plate 50, figs. 3, 4, 6.

Right valve shorter and more gibbous than *C. bicostata*, and the cardinal area higher and broader. The umbonal slope arched and forming the highest part of the shell, in front of which and separated from it by a narrow furrow is a single cord-like ridge proceeding from tip of beak to the ventral margin, though this ridge less prominent and does not rise as high as the umbonal ridge; whereas in *C. bicostata* the ridge forms the highest elevation of the shell.

On the anterior slope there is a broad, shallow sulcus, the surface rising gently before reaching the ear, but not forming a distinct second cord-like ridge as in the other species. In the specimen figured (pl. 50, fig. 6) there is a narrow, triangular area separating the broad, flattened area under the beak from the curving posterior slope of the surface. This narrow triangular area is depressed and bounded on both sides by slightly raised lines. In another specimen this triangular area is curved and separates the flat cardinal area from the curving side of the shell and consists of two strong thread-like ridges, between which are two finer parallel lines. The left valve is gibbous, but not as highly so as the right, and is marked on the anterior slope by a single low ridge separated by a faint narrow furrow from the umbonal ridge, which is broad and evenly rounded and separated from the small anterior ear by a broad, shallow sulcus.

The surface is smooth except for occasional concentric growth lines. In one mold of the exterior are seen also faint radiating lines. The two species are found in the same limestone and are clearly congeneric, the chief difference consisting in the long narrow form and more pronounced ridges of the one (*C. bicostata*) and the short gibbous form with fainter ridges of the other (*C. unicosta*).

*Locality*.—Limestone bands in the shales at northwest end of Young's Cove, Pembroke.

*Cotypes*.—Cat. No. 58442, U.S.N.M.

PTERINEA LAXATA, new species.

Plate 50, figs. 5 and 5a.

This species resembles *Avicula rectangularis* Sowerby in its general outline and in the form of the left valve. It is subtriangular, convex, with high subcarinated umbonal ridge; surface smooth; posterior margin nearly at right angles with the cardinal margin, broadly

rounded at the base. The beak, however, differs from Sowerby's species in its more central position and greater extension over the hinge area. The anterior and posterior slopes of the surface are nearly the same; a broad shallow sulcus separates the ear from the body of the shell. The right valve is convex; beak strong, narrow, and overarching; umbonal ridge at first narrow and subcarinate, but broadening out and flattening toward the base. The anterior slope is slightly concave between the umbonal ridge and the anterior ear. In one of the smaller specimens, a mold of the interior of a right valve, there is a rather sharp boundary to this sulcus, without, however, forming distinct ridges as in the case of *Cliopteria bicostata*. The dentition of hinge is as in *Pterinea*, with a long, somewhat curved linear posterior lateral tooth, and a few closely approximated oblique denticles under and a little anterior to the beak.

*Locality*.—The type-specimens are from the Silurian shales at the head of Leighton Cove, Pembroke, Washington County, Maine.

*Cotypes*.—Cat. No. 58443, U.S.N.M.

#### Genus STREPTOTROCHUS Perner.

Jaroslav Perner described the genus *Streptotrochus* in the year 1907,<sup>1</sup> as follows:

Coquille étroitement ombiliquée, à test mince et à tours légèrement aplatis, qu'on ne se touchent souvent un peu qu'à la base. Les tours possèdent une section transversale subtriangulaire et une périphérie anguleuse. Stries transverses écaillieuses, faiblement courbées; plis en spirale, peu marqués.

*Type*: *Streptotr. rugulosus* Barr. sp. (pl. 106, figs. 11–15) (Gist. et local. Bande E2, Gross-kuchel, Lochkov.).

The author recognized the following species as congeneric: *Streptotrochus mercurius* (Barrande),<sup>2</sup> *Trochus incisus* Lindström,<sup>3</sup> and with doubt *Trochus lundgreni* Lindström.<sup>4</sup>

To the genus *Streptotrochus* I refer some forms abundant in some of the shales on Moose Island associated with abundant representatives of the genus *Eurymyella*. Our species are smaller than the type-species from Bohemia and agree most nearly with Lindström's species *Trochus incisus*, but differ from that species in the less rapidly expanding spire. The form of the whorls is extremely variable, so that it is almost impossible to pick out any one specimen as a specific type to stand for other specimens crowded closely together with it on a single slab. In some of the more regular forms the resemblance to Lindström's figures of *Trochus incisus* (numbered 24 and 25 on his pl. 14) is very close. Our shells are slightly narrower and smaller in size.

<sup>1</sup> Syst. Sil. du Center Boheme, pt. 1, vol. 4, Gastéropodes, vol. 2, 1907, p. 238.

<sup>2</sup> Idem, p. 239, pl. 106, figs. 20–21.

<sup>3</sup> Kongl. Svensk. vet.-acad. Handl., vol. 19, 1884, p. 151, pl. 14, figs. 22–31.

<sup>4</sup> Idem, p. 149, pl. 14, figs. 46–53.

## STREPTOTROCHUS IONE, new species.

Plate 50, fig. 13.

Shell small, thin, whorls six, including the initial protoconch, angle of spire about 45 degrees. The second, third, and fourth (counting the protoconch as one), are simply rounded; the fifth is rather sharply carinated about halfway between the sutures; the sixth and last whorl is (on the right side of the figure) at first rounded without carination, but toward the mouth becomes indented by a furrow corresponding to the posterior face of the preceding whorl. The surface is covered by concentric lines and occasionally more prominent ridges, irregular in size and in direction, but having the appearance of having formed the outer margin of the lip at successive stages of growth.

*Locality*.—On the west side of Shackford Head, Moose Island, Eastport, Maine.

*Holotype*.—Cat. No. 58447, U.S.N.M.

## STREPTOTROCHUS REGULARIS, new species.

Plate 50, fig. 12.

This specimen is apparently made up of four whorls; the tip is broken. All of the whorls are convex and not carinated, but upon good exposure the whorls are seen to have a faint blunt angulation, and the outer whorl shows faintly the indentation more distinctly seen in the species *Streptotrochus ione*. The angle formed by the sides of the spire is approximately the same as in *Streptotrochus ione*. The surface markings consist of both the fine lines and the irregular larger concentric foldings which follow the direction of the edge of the lip.

*Locality*.—Same as *Streptotrochus ione*.

*Holotype*.—Cat. No. 58446, U.S.N.M.

## STREPTOTROCHUS CARINATUS, new species.

Plate 50, fig. 8.

This specimen is more slender than *Streptotrochus ione*, the sides forming an angle of about 35 degrees. The smaller and initial whorl is absent, but from analogy there were probably six original whorls. The last three whorls are each distinctly carinated and the carination is near the outer side and suture of each whorl; the wider or right-hand side of the whorl is flattened and hollowed immediately below the carination, forming thus a broad shallow groove. This specimen is exfoliated and the characters are based upon the surface of the anterior mold. Other specimens, however, preserving the shell show the shell to have been very thin, and except for surface markings the interior molds show the form of the exterior surface.

*Locality*.—Same as *Streptotrochus ione*.

*Holotype*.—Cat. No. 58444, U.S.N.M.

## STREPTOTROCHUS SULCATUS, new species.

Plate 50, fig. 9.

The type of this form is slightly crushed, but shows about the same size, angle, and number of whorls as in *Streptotrochus ione*. The first whorl visible (which is probably the second whorl) is simply convex, the third, fourth, fifth, and sixth whorls are each marked by distinct revolving groove or sulcus on the right side of the carina; and the carina on the outer, left side is strong but rather broad. The fine concentric lines are distinct, but the longer irregular concentric foldings seen in other specimens are wanting.

*Locality*.—Same as *Streptotrochus ione*.

*Holotype*.—Cat. No. 58445, U.S.N.M.

## REMARKS ON THE SPECIES OF STREPTOTROCHUS.

In the above descriptions I have given the distinguishing characters of four specimens selected from a number exposed to view on a single slab of shale about 6 by 3 inches in dimensions. The locality from which the slab came is probably the same from which Shaler obtained the specimens called by him "*Murchisonia desiderata*?"<sup>1</sup>

The specimens are not *Murchisonia*, and none of the specimens from the locality, or from anywhere on Moose Island, have the long slender spire of Hall's species mentioned by Shaler. The four figures given on plate 50 exhibit the general characters which are alike to such a degree that wherever found in the Eastport region, specimens can at once be located as belonging to this series. For convenience in description I have assumed that the series is a genus, and the different expressions of the type are different species; but also for convenience I have not described more specimens.

The form called *Streptotrochus carinatus* (pl. 50, fig. 8) is nearer to the type described by Lindstrom as *Trochus incisus* than the others; but our species *Streptotrochus sulcatus* (fig. 9) represents more nearly the dominant expression of characters presented by the Eastport forms. The other specimens illustrated are forms which occasionally appear and seem to be uncrushed forms of the shell. From the appearance of the fossils the shells were evidently quite fragile and have all suffered more or less by crushing after burial in the mud. The longitudinal furrowing of the whorls is almost universal, but it is varyingly expressed. The outer whorl of almost every specimen shows a trace of the furrow; in many it affects the next to last whorl, and (as in specimen called *Streptotrochus sulcatus*) the outer four whorls are distinctly sulcated. The sutures between the whorls are more or less deep, depending partly upon the abruptness of the left-hand slope from the main carination of the whorl, as seen in figure 8. All specimens are more or less strongly marked by concentric lines, and in some cases some of these lines are strengthened to form slight con-

<sup>1</sup> Amer. Journ. Sci., ser. 3, vol. 32, July, 1886, p. 58.



centric ridges, as shown in figure 13. On the specimens examined there is no constancy in expression of these ridges, and when present there seems to be no uniformity for the several whorls of the same shell. It is evident from the above that the characters upon which the four species are discriminated are quite inconstant.

## EXPLANATION OF PLATES.

## PLATE 49.

*Eurymyella shaleri* Williams.

FIG. 1. A right valve, natural size, not crushed. Shackford Head, Moose Island; collected by H. S. Williams.

2. A left valve, retaining the shell, crushed, natural size. Salt Works, Eastport; collected by N. S. Shaler.

3. A left valve, not much crushed, natural size. Salt Works, Eastport; collected by N. S. Shaler.

4. A right valve, natural size. On the east side of Seward Neck, near north Lubec landing, in thin bedded gray shale sandstone; collected by C. L. Breger.

*Eurymyella shaleri*, var. *brevia* Williams.

FIG. 5. A left valve, natural size.

6. A right valve, natural size.

7. A small left valve, natural size. Salt Works, Eastport; collected by N. S. Shaler.

*Eurymyella shaleri*, var. *longa* Williams.

FIG. 8. A left valve, natural size. East side of Seward Neck, near north Lubec landing; collected by C. L. Breger.

*Eurymyella shaleri*, var. *minor* Williams.

FIG. 9. A left valve, natural size. West side of Pleasant Point, Perry Township; collected by C. L. Breger.

*Eurymyella angularis* Williams.

FIG. 10. A left valve, natural size.

11. A right valve, natural size. East side Seward Neck; collected by C. L. Breger.

*Eurymyella? simulans* Williams.

FIG. 12. A right valve, natural size.

13. A right valve, natural size. East side Seward Neck; collected by C. L. Breger.

*Eurymyella plana* Williams.

FIG. 14. A left valve, natural size. East side Seward Neck; collected by C. L. Breger.

*Eurymyella recta* Williams.

FIG. 15. A left valve, natural size, figure made from wax impression of the original. East side Seward Neck; collected by C. L. Breger.

## PLATE 50.

Figures 8, 9, 12, 13 are magnified 2 diameters, all the others natural size.

*Chiopteria bicostata* Williams.

FIG. 1. Cardinal view of right valve, showing overarching beak and high flat area.

2. A right valve, showing the characteristic ridges on the anterior slope; the same specimen as fig. 1.

7. A left valve, showing the deep sulcus and single fold outside on the anterior slope. Specimens 1, 2, and 7, from limestone band, on the north shore of Youngs Cove, Pembroke, Washington County, Maine. Collected by C. L. Breger.

*Chiopteria uncosta* Williams.

- FIG. 3. A left valve showing the beak and umbonal ridge with a shallow furrow and single ridge on the anterior slope.
4. A right valve, the single ridge separated by slight furrow from the umbonal ridge.
6. A right valve, same specimen as fig. 4, cardinal view showing the overarching beak and flat high area; locality same as for figs. 1, 2, and 7.

*Pterinea laxata* Williams.

- FIGS. 5 and 5a. Molds of the interior of a left and a right valve, introduced here for comparison with corresponding valves of *Chiopteria* (figs. 7 and 2). Shales at the head of Leighton Cove, Pembroke, Maine. Collected by C. L. Breger.

*Streptotrochus carinatus* Williams.

- FIG. 8. An exfoliated specimen showing the interior surfaces of the whorls with angular carinae near the outer sulcus. Magnified 2 diameters. Shales in the cove on west side of Shackford Point on Moose Island, Eastport, Washington County, Maine.

*Streptotrochus sulcatus* Williams.

- FIG. 9. A partially exfoliated specimen, magnified 2 diameters, showing the revolving furrow and the concentric surface lines; collected by H. S. Williams. Locality same as fig. 5.

*Eurymyella convexa* Williams.

- FIG. 10. Mold of the interior of a left valve, natural size, showing the anterior muscular scar, umbonal and pedal scars, and, obscurely, a cardinal tooth under beak and a short oblique posterior tooth near hinge extremity. Salt Works, Eastport. Collected by N. S. Shaler.

*Eurymyella denbowensis* Williams.

- FIG. 11. A mold of the interior of front part of a right valve, natural size, showing the anterior muscular scar, umbonal and pedal scars, and the small oblique cardinal tooth under the beak. Southeast corner of Denbow Point, forming the northern extremity of Denbow Neck, Lubec Township, Washington County. Collected by C. L. Breger.
14. A nearly complete left valve, partially exfoliated, showing the anterior and pedal scars, the flattened cardinal area without lateral cardinal teeth, and the surface markings.
- Locality same as fig. 11.

*Streptotrochus regularis* Williams.

- FIG. 12. An uncrushed specimen, showing the outer surface of the shell and the sub-regular convexity of the body whorls. Magnified 2 diameters. Collected by H. S. Williams.
- Locality same as fig. 8.

*Streptotrochus ione* Williams.

- FIG. 13. A nearly perfect shell, showing the carination on the next to last whorl and sulcus on outer whorl and surface markings. Magnified 2 diameters. Collected by H. S. Williams.
- Locality same as fig. 8.